

In re Patent Application of:

VAIL ET AL.

Serial No. 09/991,559

Filing Date: **NOVEMBER 9, 2001**

REMARKS

The Examiner is thanked for the thorough examination of the present application. The specification has been amended to correct a minor typographical error. Also, independent Claim 19 has been amended to include the subject matter of its respective dependent Claim 20, which has been cancelled for consistency therewith. Independent Claims 1 and 33 have been amended to include the subject matter of their respective dependent Claims 3 and 35 (which have also been cancelled), and to recite a plurality of calibration resistors having different resistance values. Claim 4 has been amended for consistency with the amendments to Claim 1. Further, Claims 45-47 are newly added, and support therefore may be found on page 10 of the originally filed specification, for example. No new matter is being added.

The Examiner objected to a few minor informalities in the claims. In particular, the Examiner noted the use of the word "times" in the phrase "determines the temperature based upon the charging times" recited in Claims 3, 19, and 35, and he questioned whether this word should be singular. (As noted above, the subject matter of Claims 3 and 35 has now been incorporated in independent Claims 1 and 33, respectively). Each of these claims also recites that a respective charging time is measured through a circuit element/thermistor and each of a plurality of calibration resistors. Thus, there is a respective charging time associated with each of these elements (i.e., a plurality of charging times), and the temperature is determined based upon

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these charging times. Accordingly, the plural usage is correct as written.

The Examiner rejected Claims 4, 20, and 36 for certain informalities as well. Claims 20 and 36 have been cancelled, and the noted informalities with respect to Claim 4 have been addressed by the above-noted amendments.

In view of the amendments and the supporting arguments presented in detail below, it is submitted that all of the claims are patentable.

I. The Claimed Invention

The present invention is directed to a temperature sensor. As recited in amended independent Claim 1, for example, the temperature sensor includes a capacitor, a circuit element coupled in series with the capacitor and having a resistance that varies with temperature, and a plurality of calibration resistors coupled to the capacitor and having different resistance values. The temperature sensor also includes a controller for sequentially charging the capacitor through the circuit element and each of the calibration resistors. The controller is also for measuring respective charging times required to charge the capacitor to the predetermined threshold through the circuit element and the calibration resistors, and determining the temperature based upon the charging times. Accordingly, the temperature sensor not only provides a high degree of accuracy, but it is also easy to calibrate.

Amended independent Claim 19 is directed to a similar

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temperature sensor, and independent Claim 33 is directed to a related method. Each of these claims similarly recites charging a capacitor through a circuit element/thermistor and a plurality of calibration resistors, measuring charging times associated with each, and determining temperature based upon the charging times.

II. The Claims Are Patentable

As noted above, independent Claims 1, 19 and 33 have been amended to include the subject matter of their respective dependent Claims 3, 20, and 35. Claims 1 and 33 have also been amended to include subject matter similar to that recited in original Claims 4 and 36, respectively, namely a plurality of calibration resistors having different resistance values. Claims 4, 20, and 36 were rejected based upon Levine et al. (U.S. Patent No. 4,841,458) in view of Chen et al. (U.S. Patent No. 6,100,510).

Levine et al. is directed to a method for forming a digital signal representing an environmental condition, such as temperature. The method includes measuring the variable time constant of an analog sensing device having a variable resistance dependent upon the environmental condition and a capacitor, as well as measuring the reference time constant of a precision fixed resistor and the same capacitor. The time constants are measured by discharging the capacitor, charging the capacitor through the appropriate element, and measuring the time for the voltage across the capacitor to reach a predetermined level.

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Lastly, the digital ratio between the two time constants is formed. This digital ratio is the digital representation of the temperature by the analog sensing device. See, e.g., abstract of Levine et al.

The Examiner correctly acknowledges that Levine et al. fails to teach the use of high and low calibration resistors as recited in Claim 19. Nonetheless, the Examiner contends that Chen et al. provides this noted deficiency. Chen et al. teaches a heating unit including a temperature sensor. More particularly, the heating unit includes a Wheatstone bridge in which one arm of the bridge serves as the heating element. When the heating element cools, the bridge becomes electrically unbalanced, which causes a heating current to once again flow through the heating element to restore its temperature. See summary of Chen et al. As such, the Examiner contends that the resistors in the various arms of this Wheatstone bridge provide high and low value resistors as recited in Claim 4.

It is respectfully submitted that the proposed combination of Levine et al. and Chen et al. is improper, because to modify the device of Levine et al. as proposed by the Examiner would change the principle of operation thereof. More particularly, Levine et al. discloses measuring a time constant for charging a capacitor separately through a single precision fixed resistor and a thermistor, and using the two time constants in a ratio to determine temperature. Yet, the Wheatstone bridge of Chen et al. relies upon an electrical unbalance between

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resistor arms to determine when a balance point has been crossed, which corresponds to a single desired temperature value (see, e.g., col. 4, line 54 through col. 5, line 18). That is, the Wheatstone bridge resistors are not used to measure time constants corresponding to each resistor which can then be used to determine temperature. Rather, they are used to define a balance point corresponding to a desired temperature value.

Accordingly, to somehow selectively combine the Wheatstone bridge resistor configuration of Chen et al. with the circuit of Levine et al. would change the principle of operation thereof. That is, the Levine et al. circuit would no longer be determining an actual temperature value based upon time constant ratios. Instead, it would be determining when one particular temperature value was reached based upon an electrical balance point.

Similarly, the combination of Levine et al. and Chen et al. is also improper because it renders the Levine et al. device unsatisfactory for its intended purpose. That is, Levine et al. seek to calculate an actual temperature value for use in air conditioning applications using time constant ratios. Yet, the resistors of the Chen et al. Wheatstone bridge are simply used to detect when an electrical balance point corresponding to a desired temperature has been crossed.

Accordingly, it is submitted that independent Claim 19, which includes the subject matter of original dependent Claim 4, is patentable over the prior art. Further, independent Claims 1

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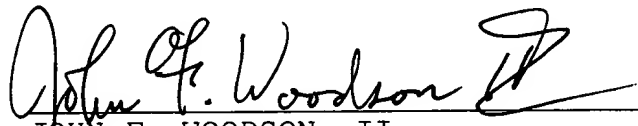
and 33 recite subject matter which similarly defines over the prior art for the same reasons discussed above with respect to Claim 4. Their respective dependent claims, which recite yet further distinguishing features, are also patentable over the prior art and require no further discussion herein.

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CONCLUSIONS

In view of the amendments to the claims and the arguments presented above, it is submitted that all of the claims are patentable. Accordingly, a Notice of Allowance is respectfully requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,



JOHN F. WOODSON, II
Reg. No. 45,236
Allen, Dyer, Doppelt, Milbrath
& Gilchrist, P.A.
255 S. Orange Avenue, Suite 1401
Post Office Box 3791
Orlando, Florida 32802
Telephone: 407/841-2330
Fax: 407/841-2343
Attorney for Applicants